The work does not attempt to straighten out the great confusion arising from different names having been bestowed on the hydroid and medusa phases of the same species, and vice versa, *i. e.*, the same names given different species and genera. While this is, of course, to be regretted, the author is fully justified in his statement (p. 3), "These and many other cases of a similar nature interpose a barrier to our attempt to invent a system which includes all hydroids and medusæ in its embrace." The hopelessness of such an attempt is realized when we see that two thirds of the genera of Leptomedusæ in which both hydroid and medusa forms are known have different names for the colonial and medusoid phases in the life history of the same species.

He has been careful, however, to give the hydroid name, whenever it is known, in discussing each species, as well as a description, and often figures, of each hydroid which is known to produce medusæ.

The carefully prepared synonymies under each genus and species is particularly valuable in pointing out the errors of previous writers, as well as giving all names by which the species or genus has been known; *e. g.*, under "*corynitis* McCrady" he says: "Non *Corynitis* Murbach, non *Corynitis* Nutting, non *Corynitis* Hargitt," thus correcting a serious error which had been made by successive writers. It is unfortunate, however, that these synonymies are printed in such small type as to be trying to the eyes when they are studied for any considerable length of time.

The work is replete with interesting facts concerning the embryological and experimental discoveries regarding the species discussed, including a very complete résumé of all that is known through the investigations of the numerous workers in this group.

The author regards the Trachymedusæ and Leptomedusæ as being transformed actinules, and the Anthomedusæ and Leptomedusæ as being formed on a different plan, with their bells not homologous with those of the first-named orders. A further discussion of this exceedingly important point would have been much appreciated by Dr. Mayer's fellow workers.

In one respect the work could have been improved. It seems to the reviewer that a preliminary discussion of the morphology of the group, or of the several orders, corresponding in general to that given by Allman in his "Gymnoblastic Hydroids" would have been very helpful, especially to those interested in the medusæ but not familiar with the technical terms employed and the homologies of the parts, particularly those homologies which exist between the various parts of the hydranth and medusæ and the various forms of gonosome.

There is also occasional inconsistency in sometimes including and sometimes omitting the name of the authority after the specific name: *e. g.*, "*Steenstrupia rubra* Forbes" and "*Steenstrupia aurata*" (pp. 31, 35).

The reviewer, however, so thoroughly admires this excellent piece of work that he finds himself in no mood for criticism of small details. "Medusæ of the World" is a monumental work which will take the very first rank and be a classic of which the Carnegie Institution may well be proud, and for which the author is to be heartily congratulated.

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Identification of the Commercial Dyestuffs. By Professor SAMUEL PARSONS MULLIKEN, of the Massachusetts Institute of Technology. New York, John Wiley & Sons. 1910.

This elaborate treatise has just appeared as Vol. III., of the author's "Method for the Identification of Pure Organic Compounds," and represents an enormous amount of careful and laborious investigation on the part of Professor Mulliken and his assistants. They present here careful records of ten or more separate tests, some of them involving the skillful use of the spectroscope, upon nearly 1,500 different dyestuffs; and the results of these experiments have been expressed in the form of elaborate analytical tables, by which,

as in a system of qualitative analysis, this great mass of compounds has been split up and divided and subdivided into general divisions, subdivisions and sections. Presumably, by the systematic use of these tables, after a very considerable amount of practise on the tests themselves, it ought to be possible for a careful manipulator, without any previous knowledge of dyestuffs, and with absolutely no experience in the art of dyeing, to separate and positively identify any one of these hundreds of dyestuffs, much as a college freshman can separate and identify barium or bismuth in a qualitative mixture.

Whether these elaborate tables and this vast number of carefully classified experiments will accomplish this desired result, as the author evidently expects, seems to the present writer to be still rather an open question.

He has not had the leisure to spend some weeks of constant work, in making himself familiar with the methods described, and with the rather formidable looking hieroglyphics in which the results of the experiments are expressed—work which would certainly have to be done before he could test the analytical tables upon commercial dyestuffs.

While glancing over the book, however, he did notice one place, at any rate, where the system seemed at fault. On page 52, under Genus I., Division B, Section of Orange Yellow Colors on Wool, No. 81, can be found carefully described the well-known mordant dyestuff of the Meister Lucius and Brüning Co., Cœruleine S, powder. This division of Genus I., by the way, corresponds, so it is stated, to azines, oxazines, thiazines, etc. Just what the chemical classification of Cœruleine S really is, the writer does not know, nor, indeed, care. But he does know that the same Meister, Lucius and Brüning Co. sell exactly the same dyestuff, in a paste form, under the name of Cœruleine, S. W. Paste. And it was, accordingly, with some surprise that this latter coloring matter was found as No. 1,153, page 224, carefully located in Genus IV., Division B, Subdivision 1, Section of Green Colors on Wool, under the heading of "Pyronine, Thiobenzyl and Azo-derivatives." It seems curious that the addition of a little water should make such a difference!

It is, of course, impossible that in such an elaborate and complicated work as this no errors should arise. Very possibly this is the only case of that sort in the book; although it would be interesting to have a study made of it by representatives of the great color houses, who, each knowing their own dyestuffs, could readily pick out any similar slips, if they were present.

A more serious criticism, that may with good faith be directed against this remarkable monument of industry, is that the distinguished author, full of his scheme for a vast qualitative separation of pure organic compounds of every description, has attacked this most practical problem of the identification of dyestuffs, from a purely theoretical standpoint. To paraphrase Wordsworth, "A dyestuff by the river's brim, an *organic compound* is to him and nothing else." He has treated these coloring matters as though they were part of a collection of organic chemicals on the shelves of a chemical museum, whose labels had fallen off; and in no part of the book is there a suggestion of the importance of assisting the practical dyeing chemist in his work, or of calling in his assistance, in return.

Now this attitude, it seems to the writer, is distinctly unfortunate, and very seriously interferes with the value of the book for any purpose, excepting, possibly, as a storehouse from which, with a good deal of difficulty, some information can be dug out about special scientific tests for a vast number of dyestuffs. It is very doubtful whether, as matters now stand, any dyeing chemist would go so far out of his way as to try to solve a dyeing problem by means of these quite unpractical schemes and separations. And, most of all, the more carefully and conscientiously these analytical tables are studied and experimented with, the more hopelessly astray would the student find himself, when brought face to face with any practical dyeing problem.

For these dyestuffs are not simply organic

compounds belonging to the azine or pyronine or oxyketone or other classes, according to their composition and the arrangement of their atoms or their molecules. They are important and indeed fundamental tools in a great industry, and are of interest and of value, not on account of their composition, but for their power of coloring various substances useful and valuable shades of color. And everybody who has anything to do with dyestuffs, outside of a research organic laboratory, studies them with this practical end in view. Their number and variety are so great that in order to get any idea of them at all they must be classified. But these classes, excepting, as before, in some research organic laboratories, are invariably based upon their dyeing properties. Not one dyeing chemist in a hundred could distinguish a thiazine from a thiobenzenyl derivative; but every one of them, from the gray-haired chief of a great color laboratory, to the bright-eyed laboratory boy picking up points about dyes in the intervals of scrubbing the floors or washing out beakers, would know the difference between, for instance, a vat dye and a basic dye—would know how they were applied, upon what fibers, with what general results—in other words, would know how they were used and what they were used for. These classes are not numerous, perhaps seven in all—the direct cotton or salt colors, basic, acid, mordant, vat, sulphur and developed colors. But into these seven classes, all commercial dyestuffs, not only *may* be divided, but *must* be divided, in order to have any idea of how they can be utilized.

The next most important and most distinctive characteristic of a dyestuff is that it dyes some particular color—on wool, cotton or other textile fiber. This furnishes a second, very simple and extremely practical method of subdivision. First, we determine *how* a coloring matter dyes, and, secondly, *what color* it dyes. These two tests can be made in a very few minutes, furnish most valuable practical information, and, in a great majority of cases, furnish all the information that it is necessary to know about a color.

If a dyer is asked to give an estimate on a thousand pounds of cotton yarn to dye to match a given sample, he certainly does not care about the chemical composition of that color, nor, excepting under special circumstances, about the absolute identity of that particular dyestuff. If the chemist tells him what class the color belongs to, whether a salt color, cheap and not fast to washing, or a vat color, very expensive, and exceedingly fast to both washing and light, or a sulphur color, fast to washing and not to light, or a basic color, very brilliant, quite fugitive in sunlight, needing careful mordanting before dyeing, or even a mordant or alizarine color, with all the trouble and expense that that means—then the dyer can estimate at once the expense of matching that color, and the problem is solved.

Accordingly, in every dyeing laboratory, and in almost any, if not every, dyeing school, the students are first taught this practical classification, and then the different important dyes in each class, and what their peculiarities are. After some experience the chief colors in each class come to have an individuality, so that they can be recognized at once, as soon as they are dyed. As one dyeing chemist told me, "It's like recognizing a boy you have known among a crowd of others. You can't tell offhand just what strikes you about him, but *'That's Johnnie.'*" And every hour's work on the dyes, working with the practical side in view, teaches more and more about their properties, and enables the problems that come in to be solved more readily and rapidly.

And this is necessary, for in a dyeing laboratory the problems are apt to come in fast and thick. The morning's mail may bring in samples of colors, batches of yarns, scraps of linen, cotton, silk, artificial silk and mixed goods, paper, calico, pigment and the like, in bewildering numbers, all to be matched, and in some cases identified, and all to be finished and cleared up before closing hours, or at latest before next morning's mail is distributed. There is no time here for elaborate

tests, based on chemical composition, for genera and divisions and subdivisions and sections, for careful study with the spectroscope in a dark room, to determine whether a dyestuff is a triphenyl methane or a nitro derivative. The sample is taken up, the class determined and noted. It is found, for instance, to be a salt color, on cotton, unmixed, a rather dark shade of red. Out come the well-thumbed sample books, Cassella, Metz, Badische, Elberfeld, perhaps one or two others, who have a good line of those colors. The page of red salt colors on cotton is reached, the sample is compared. In a minute or two more it is checked off—probably Diamine Fast Red B, Cassella—or Dianil Red BB, Metz; then these are looked up in Schultz & Julius, last edition, one or two simple tests are made—probably a dab or two of acid on each—and the color is identified.

In many cases the experience of the laboratory will fix on the color, and the sample books, like the chemical tests, will only be needed as confirmation. The sample, for instance, is red worsted yarn, used in stockings. The tests show an unmixed acid color, not after chromed. It must, to be satisfactory, be fast to washing and to perspiration. Only one or two colors *of this class* answer these requirements. The chemist knows, then, at once, that it must be this, or that, or the other. A few simple tests, and the particular one is determined.

A specially unfortunate result of the purely theoretical character of the tests in this book is the extraordinary way in which colors of entirely different classes and shades, come out together in the final separations. The sections, into which the compounds are finally classified, after being broken up into genera, divisions and subdivisions, are based on the shades given on wool. Every dyeing chemist, when he first sees that, will recognize it as a natural and useful method of final classification. Imagine his astonishment, then, when he inspects the colors forming one of these sections, as, for instance, one taken at random on page 64, headed "Section of Yellow Orange Colors on Wool," and finds among the eight colors there set down, Indian yellow J (an acid yellow used on wool and silk), six salt colors, dyeing cotton various shades of orange, and a *leather black!* In almost every section can be found acid and basic, salt and vat colors mixed together in almost inextricable confusion, and, thanks to the strange way in which the dyeing tests on wool are made, instead of the red colors being by themselves, and the blues and violets and oranges all separated, as they would have to be for any useful purpose, every color of the spectrum may be brought together in the same class.

A Color Standard.—There is, however, one feature of Professor Mulliken's book which, so far as we know, is new, and which might be made extremely useful. In a pocket in the back cover of the book are placed three cardboard sheets, containing a very carefully constructed color standard of nearly 150 different shades, most conveniently arranged for comparison and identification. This color standard is constantly referred to, in the book, and wherever possible every single one of all the many thousands of tests set down in the tables has the color reaction carefully and accurately classified to correspond to its place in the standard.

This suggests an idea which might be developed into a treatise on modern dyestuffs, which would be of real interest and value to dyeing chemists all over the world. The difficulty with "Schultz & Julius," and with "Knecht, Rawson and Loewenthal," is that they do not give sample dyeings of the colors they describe, and so must be supplemented, for practical use, by collections of sample cards of the great dyehouses, or by home-made collections of dyed samples, carefully noted and indexed, in order to get a good idea of the color produced by each dyestuff.

On the other hand, Lehne's large and valuable book, published in 1893, containing dyed and printed samples of the colors described in the last Schultz & Julius catalogue of that time, was so exceedingly difficult and expensive to prepare that it has proved impossible to keep it up to date.

But, by using these very excellent color

standards of the Milton Bradley Co., as contained in this book of Professor Mulliken's, it would be possible to accurately describe and identify the exact shade of the characteristic sample dyeings, without pasting a single sample in the book. And, by a proper system of classification, the chemist attempting to identify a color, after determining its class, and dyeing a sample, would determine its exact place in the color table, and so avoid the necessity of hunting it up in the sample books of the different color houses, or in his own sets of home-made samples.

To be of real value, such a treatise should be written by a well-trained color chemist, thoroughly familiar with the dyestuffs of today, from their practical side, and accustomed to face, in his regular work, the many and varied problems in textiles, paper-making, pigments, food products and the like, which appear every day in a large dyeing laboratory.

The theoretical part of such a book could be easily obtained from the treatises we have at present, including this one of Professor Mulliken's. But the use of the color standard would give opportunity for identifying the shades with a minimum of trouble and expense; and if the writer would incorporate some of the regular laboratory information about methods, and about the practical peculiarities of the different dyestuffs, their ease of dyeing, comparative fastness, special uses, cost prices as compared to others of the same or different classes, and a host of other minor matters of practical interest to users and workers with the dyestuffs, such a book would be hailed with enthusiasm by dyeing chemists from one end of the world to the other.

CHARLES E. PELLEW

October 5, 1910

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of the *American Journal of Mathematics* for October are:

"q-Difference Equations," by Rev. F. H. Jackson.

"On the Relation between the Sum-formulas of Hölder and Cesàro," by Walter B. Ford.

"Sur un Exemple de Fonction Analytique Partout Continue," par D. Pompeiu.

"Symmetric Binary Forms and Involutions," by Arthur B. Coble.

"Systems of Tautochrones in a General Field of Force," by Harry Wilfred Reddick.

"The General Transformation Theory of Differential Elements," by Edward Kasner.

BOTANICAL NOTES

TWO RECENT BOOKS ON LICHENS

WITHIN a few weeks of each other two notable contributions to our knowledge of the lichens of this country have been issued. The first is Albert W. C. T. Herre's "Lichens Flora of the Santa Cruz Peninsula, California," published in the *Proceedings of the Washington Academy of Sciences* (Vol. XII., No. 2) and bearing date of May 15, 1910; while the second is Bruce Fink's "Lichens of Minnesota" published in the Contributions from the United States National Herbarium (Vol. 14, Part 1) and bearing date of June 1, 1910. The first contains 243 pages, and the second 256 pages, with 51 plates and 18 text-figures. They are both nominally local lichen floras, and judged by their titles alone might be supposed to present a similar mode of treatment. However a comparative examination of the two works shows a marked difference between them. Thus while both accept Zahlbruckner's general understanding of the lichens, the first author proceeds at once to the descriptive part of his book, evidently assuming that the reader will bring to its perusal all the necessary knowledge for its full understanding. In Professor Fink's book, on the contrary, there is an explanatory introduction in which there is a discussion of the nature of lichens, and the views that have prevailed during the past two centuries. This is followed by a particular discussion of what is known of their structure and reproduction, including under the latter sexual reproduction. Here he says "the sexual processes have not been studied in very many of the fungi most closely related to the lichens, but recent discoveries seem to indicate that sexuality is common there and in the ascomycetous lichens as well. In Collema, Stahl and others have found that the apothecium is